BAYOU COURTABLEAU TMDL FOR SALINITY/TOTAL DISSOLVED SOLIDS

SUBSEGMENT 060204

US EPA Region 6

Final

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EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify waterbodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those waterbodies. A total maximum daily load (TMDL) is the amount of a pollutant that a waterbody can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources discharging to the waterbody. A TMDL has been developed for salinity/total dissolved solids (TDS) for Bayou Courtableau. Throughout the rest of this document, the term TDS will be used to signify also salinity.

Bayou Courtableau flows from its headwaters to West Atchafalaya Barrow Pit Canal, then into the Vermillion-Teche Basin. Bayou Courtableau, subsegment 060204, was listed on the October 28, 1999 Court Ordered §303(d) List as not fully supporting the water quality standard for propagation of fish and wildlife. Louisiana's water quality standards for chloride, sulfate, and TDS is applied as follows:

> "Numerical criteria for these parameters generally represent the arithmetic mean of existing data from the nearest sampling location plus three standard deviations. For estuarine and coastal marine waters subsegments in Table 3 that have no listed criteria (i.e., designated N/A), criteria will be established on a case-by-case basis using field determination of ambient conditions and the designated uses. For water bodies not specifically listed in the Numerical Criteria and Designated Table, increases over background levels of chloride, sulfate, and TDS may be permitted. Such increases will be permitted at the discretion of the office on a case-by-case basis and shall not cause in-stream concentrations to exceed 250, 250, and 500 mg/l for chloride, sulfate, and TDS, respectively, except where a use attainability analysis indicates that higher levels will not affect the designated uses. In permitting such increases, the office shall consider their potential effects on resident biota and downstream water bodies in addition to the background conditions. Under no circumstances shall an allowed increase over background conditions cause any numerical criteria to be exceeded in any listed water body or any other general or numerical criteria to be exceeded in either listed or unlisted water bodies."

One year (January, 1998 – December 1998) of monthly LDEQ TDS data on Bayou Courtableau (water quality station 0665) was assessed to determine if the propagation of fish and wildlife use was being maintained. Analysis of the data shows that the propagation of fish and wildlife use is not protected (see Appendix A). Therefore, a TMDL has been developed for TDS.

TDS data were not available at LDEQ water quality station 0665 and were therefore estimated. A multiplying factor was developed using the available field conductivity and TDS data from LDEQ water quality station 0101 on Bayou Courtableau. An ANOVA on sulfate and conductivity data showed there was no statistically significant difference in sulfate concentrations ($p < 0.18$, $n=12$) or conductivity values ($p < 0.49$, $n=12$) between the two stations (Appendix C). Therefore, the data from station 0101 were used to calculate a multiplying factor by dividing TDS values (mg/l) by field conductivity values (μmhos) for each sampling date and then taking the average. TDS was then estimated using a more recent field conductivity data set from WQ station 0665 on Bayou Courtableau (June, 1998 – December, 1998), against which the multiplier (1.02 mg/l/μmho) was applied. Seventy five percent of the estimated TDS data exceeded the TDS criterion of 220 mg/l (see Appendix A). Therefore, a TMDL was developed to protect the propagation of fish and wildlife use.

For the purpose of calculating current loading on Bayou Courtableau, the average TDS concentration of 334.22 mg/l was calculated using the estimated monthly data on Bayou Courtableau water quality station 0665. At this station, the monthly TDS concentrations range from 106.08 mg/l to 440.64 mg/l over the collection period (June, 1998 – December, 1998).

For the purpose of TMDL development, the criterion of 220 mg/l was applied. The TDS TMDL was developed based on simple dilution calculations using average flow and the State TDS criterion of 220 mg/l. The TMDL calculation includes wasteload allocations, load allocations, and a margin of safety. A 34 % reduction in TDS loading will be needed to meet the standard for the propagation of fish and wildlife.

1. Introduction

Bayou Courtableau segment 060204 was listed on the October 28, 1999 Court Ordered §303(d) List as not fully supporting the water quality standard for propagation of fish and wildlife and was ranked as a high priority for TMDL development. A TMDL for salinity/total dissolved solids (TDS) was developed in accordance with the requirements of Section 303 of the federal Clean Water Act. The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant; the TMDL also establishes the load reduction that is necessary to meet the standard in a waterbody. The TMDL consists of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The wasteload allocation is the load allocated to point sources of the pollutant of concern, and the load allocation is the load allocated to nonpoint sources. The margin of safety is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions and data inadequacies.

2. Study Area Description

2.1 General Information

Water quality segment 060204 is part of the Vermilion-Teche River Basin. The Basin encompasses the prairie region of the State and a section of the coastal zone. Bayou Courtableau is located in southwestern Louisiana in the Vermillion-Teche River Basin. The Vermilion-Teche River Basin is bounded on the north by the Red River Basin, on the east by the Atchafalaya Basin, on the west by the Mermentau River Basin and southward by the Gulf of Mexico. Land use in the Vermilion-Teche Basin is largely agriculture, the primary crops being corn, soybeans, and milo. The area is sparsely populated outside its small municipalities. Land use is dominated by agriculture. The average annual rainfall in the vicinity of Bayou Courtableau is approximately 57 inches. The land use for Bayou Courtableau watershed is summarized in Table 1.

Table 1. Land Uses in Segment 060204

LAND USE TYPE	NUMBER OF ACRES	% OF TOTAL AREA
Urban	125	0.1
Agricultural	76,742	63.8
Forest Land	221	0.2
Water	4,775	4.0
Wetland	38,319	31.8
Rangeland	163	0.1
TOTAL AREA	120,345	100

2.2 Water Quality Standards

The designated uses for Bayou Courtableau include primary contact recreation, secondary contact recreation, and propagation of fish and wildlife. TDS serves as the indicator for the water quality criterion and is used in the assessment of use support. Louisiana's water quality criterion for TDS is 220 mg/l for subsegment 060204.

2.3 Identification of Sources

The sources identified in the *1998 Louisiana Water Quality Inventory* as affecting the water quality of the Vermilion River are unknown sources (LDEQ, 1998).

2.3.1 Point Sources

Several minor point sources fall within the subsegment. Many of these facilities are either intermittent stormwater or minor discharges. Five facilities are known to discharge sanitary wastewater into the Bayou Courtableau subsegment. The combined flow of all these discharges is 72,425 gallons per day (see Table 2).

Table 2. Dischargers in Subsegment 060204

Dischargers to Bayou Courtableau			
Facility	Permit #	Design Flow (MGD)	Wasteload Allocation (lb/day)*
Washington Campground	LAG530762	0.025	45.87
Tri-Community Nursing Center/Peace Inc.	LAG540553	0.0108	19.82
Palmetto Elderly Apartments	LAG540556	0.025	45.87
Morrow Housing Project	LAG540685	0.0075	13.76
Washington Elementary School	LAG540896	0.004125	7.57
	Totals:	0.072425	132.89

* loads calculated using 220mg/l criterion and design flow.

2.3.2 Nonpoint Sources

The predominant land uses in the Bayou Courtableau watershed are agriculture and forestry, both of which contribute to TDS loads through runoff. There are also numerous rural residences where other domesticated animals may be found. These rural residences may also contribute to the TDS load if they have septic tanks or septic fields for their wastewater treatment. It is presently unknown to what relative extent all of these sources contribute to TDS loads. (LDEQ, 1993)

3. TMDL Load Calculations

3.1 Current Load Evaluation

TDS loads have been calculated using the instream TDS concentration and the flow of the stream. The following equation can be used to calculate TDS loads.

Equation 1. C x Q in cfs x 5.39 lb/day or C x Q in MGD x 8.34 lb/day

Where: C = concentration in mg/l
Q = stream flow in cfs or MGD

A traditional expression of the load may be developed by setting one critical or representative flow and concentration, and calculating the TDS load using Equation 1. The difficulty with this approach is in the determination of the appropriate flow or concentration value to use.

TDS data were not available at LDEQ water quality station 0665 and were therefore estimated. TDS can be estimated by multiplying conductivity values by a multiplier. For the analyses of natural waters, the multiplier ranges from 0.55 to 0.96 (mg/l/μmhos), the higher values generally being associated with waters high in sulfate concentrations (Hem, 1985, page 67). In this TMDL, a multiplying factor was developed using the available field conductivity and TDS data from LDEQ water quality station 0101 at Bayou Courtableau. The data available at this station is from March 15, 1988 through December 10, 1990. Since there was only one year of data from Station 0665, the most recent year of sulfate and conductivity data from station 0101 (1990) was used in an ANOVA to determine if the values were similar between stations (Appendix C). Since there was no statistically significant difference in sulfate concentrations ($p < 0.18$, $n=12$) or conductivity values ($p < 0.49$, $n=12$) between the two stations, the data from station 0101 were used to calculate a multiplying factor. Dividing TDS values (mg/l) by field conductivity values (μmhos) for each sampling date and then taking the average resulted in a multiplying factor of 1.02 mg/l/μmho. TDS was then estimated by multiplying the field conductivity data from WQ station 0665 on Bayou Courtableau (June, 1998 – December, 1998) by the multiplier (1.02 mg/l/μmho). Seventy five percent of the estimated TDS data exceeded the TDS criterion of 220 mg/l (see Appendix A). Therefore, a TMDL was developed to protect the propagation of fish and wildlife use.

For the purpose of calculating current loading on Bayou Courtableau, the average TDS concentration was calculated using the same estimated monthly data set. In Bayou Courtableau, the estimated monthly TDS concentrations ranged from 106.08 mg/l to 440.64 mg/l over the collection period (June, 1998 – December, 1998). The average TDS concentration is 334.22 mg/l (see Appendix A). The average flow for Bayou Courtableau is 1,114 ft^3/sec (see Appendix B). Using these values and Equation 1, it is estimated that the current loading for TDS is 2,006,810.62 lb/day.

3.2 TMDL

Point sources usually have a defined critical receiving stream low flow such as the 7Q10 (or Harmonic mean flow) at which the criterion must be met. For nonpoint sources it is recognized that there may be no single critical flow condition. The load reduction needed to meet the water quality standard for propagation of fish and wildlife in Bayou Courtableau at 1,114 cfs is 685,829.42 lb/day (34% reduction). This was obtained by calculating the allowable TMDL at 1,114 cfs for the 220 mg/l criterion (1,320,981.20 lb/day) and subtracting this load from the observed load (2,006,810.62 lb/day).

Current Load - TMDL = Load Reduction

2,006,810.62 lb/day – 1,320,981.20 lb/day = 685,829.42 lb/day

3.3 Wasteload Allocation (WLA)

The Louisiana Water Quality Regulations require permitted point source discharges of treated sanitary wastewater to maintain an in-stream TDS concentration of 220 mg/l on this subsegment. Therefore, there may be a need to include a TDS limit as the permit requirement based upon a wasteload allocation resulting from this TMDL.

Equation 1 can be used to calculate the total point source load (wasteload allocation) utilizing the water quality criterion for TDS of 220mg/l and the design flow of all the wastewater dischargers (0.072425 million gallons/day) (Table 2).

Cstd mg/l * Q in MGD * 8.34 = WLA lb/day

Where, Cstd is the water quality standard and Q is the discharge design flow from permitted facilities in subsegment 060204 thus:

WLA for TDS = 220 mg/l x 0.072425 MGD x 8.34 = 132.89 lb/day

See Table 2 for individual wasteload allocations.

3.4 Load Allocation (LA)

The load allocation at a given flow can be calculated using Equation 1 and the following relationship:

(TMDL@ given flow and criterion) - (WLA)= LA

LA for instream flow of 1,114 cfs = 1,320,848.30 lb/day

1,320,981.20 lb/day (TMDL@ 1,114 cfs) – 132.89 lb/day (WLA) = 1,320,848.30 lb/day

3.5 Seasonal Variability

Louisiana's water quality standard for TDS is for January through December. Therefore, no seasonal TMDL for TDS was developed.

3.6 Margin of Safety (MOS)

The Clean Water Act requires that TMDLs take into consideration a margin of safety. EPA guidance allows for the use of implicit or explicit expressions of the margin of safety or both. When conservative assumptions are used in the development of the TMDL or conservative

factors are used in the calculations, the margin of safety is implicit. When a percentage of the load is factored into the TMDL calculation as a margin of safety, the margin of safety is explicit. In this TMDL for fecal coliform, conservative assumptions have been used and therefore, the margin of safety is implicit. These conservative assumptions are:

- Using average flows to calculate current loading to obtain load reduction.
- Treating TDS as a conservative pollutant, that is, a pollutant that does not degrade in the environment.
- Using the TDS water quality standards of 220 mg/l as established by Louisiana water quality standards rather than using site-specific criteria and seasonal variability factors.
- Using the design flow of the point source dischargers rather than actual average flow rates, which are typically much lower (as applicable).

4. Other Relevant Information

Although not required by this TMDL, LDEQ utilizes funds under Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act to operate an established program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface waters, to develop a long-term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the State's biennial 305(b) report (*Water Quality Inventory*) (LDEQ, 1998) and the 303(d) list of impaired waters. This information is also utilized in establishing priorities for the LDEQ nonpoint source program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary to yield at least 12 samples per site each year. Sampling sites are located where they are considered to be representative of the waterbody. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been established by the time the first priority basins are monitored again in the second five-year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following establishment of the TMDLs. As the monitoring results are evaluated at the end of each year, waterbodies may be added to or removed from the 303(d) list. The sampling schedule for the first five-year cycle is shown below. The Vermilion-Teche River Basin will be sampled again in 2003.

1998 – Mermentau and Vermilion-Teche River Basins
1999 - Calcasieu and Ouachita River Basins
2000 – Barataria and Terrebonne Basins

2001 – Lake Pontchartrain Basin and Pearl River Basin
2002 – Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.)

In addition to ambient water quality sampling in the priority basins, the LDEQ has increased compliance monitoring in those basins, following the same schedule. Approximately 1,000 to 1,100 permitted facilities in the priority basins were targeted for inspections. The goal set by LDEQ was to inspect all of those facilities on the list and to sample 1/3 of the minors and 1/3 of the majors. During 1998, 476 compliance evaluation inspections and 165 compliance sampling inspections were conducted throughout the Mermentau and Vermilion-Teche River Basins.

5. Public Participation

When EPA establishes a TMDL, 40 C.F.R. § 130.7(d)(2) requires EPA to publicly notice and seek comment concerning the TMDL. Pursuant to an October 1, 1999, Court Order, EPA prepared this TMDL. After submission of this TMDL to the Court, EPA commenced preparation of a notice seeking comments, information and data from the general and affected public. Comments and additional information were submitted during the public comment period and this Court Ordered TMDL was revised accordingly. EPA has transmitted this revised TMDL to the Court, and to the Louisiana Department of Environmental Quality (LDEQ) for incorporation into LDEQ's current water quality management plan.

REFERENCES

Arcement, G.J., L.J. Dantin, C.R. Garrison, and W.M. Lovelace. 1992. Water Resources Data Louisiana Water Year 1991. U.S. Geological Survey Water-Data Report LA-91-1. 435pp

Hem, John D. 1985. *Study and Interpretation of the Chemical Characteristics of Natural Water.* Third Edition. United States Geological Survey Water-Supply Paper 2254. U.S.Government Printing Office.

LDEQ, 1993. *State of Louisiana Water Quality Management Plan, Volume 6, Part A: Nonpoint Source Pollution Assessment Report*. Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge, La.

LDEQ, 1998. *State of Louisiana Water Quality Management Plan, Volume 5, Part B: Water Quality Inventory*. Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge, La.

APPENDIX A. Specific Conductance and TDS data

Bayou Courtableau in Port Barre, LDEQ WQ Station 0665

DATE	TIME	Specific Conductance (μmhos)	Estimated TDS (mg/l)*
12/9/98	1030	210.0	214.20
11/24/98	1025	104.0	106.08
11/10/98	0750	352.0	359.04
10/28/98	1145	357.0	364.14
10/14/98	1037	432.0	440.64
9/23/98	1115	137.0	139.74
9/9/98	1051	459.0	468.18
8/26/98	1110	404.0	412.08
8/12/98	1140	382.0	389.64
7/29/98	1058	361.0	368.22
7/15/98	0900	359.0	366.18
6/24/98	1107	375.0	382.50

*calculated by multiplying specific conductance by 1.02mg/l/μmho

n = 12

TDS criterion = 220 mg/l

Exceedance rate = 9/12 = 75%

Average concentration = 334.22 mg/l

(Reference: http://www.deq.state.la.us/surveillance/wqdata/0665wqnf.txt)

APPENDIX B. Flow Information

USGS station #07382500: Bayou Courtableau at Washington, LA. Period of record – July 1946 to 1991. Average discharge – 45 years, 1114 ft^3 / s, 807,100 acre-feet/year. (Taken from Arcement, G.J., L.J. Dantin, C.R. Garrison, and W.M. Lovelace. 1992. Water Resources Data Louisiana Water Year 1991. U.S. Geological Survey Water-Data Report LA-91-1. 435pp.)

APPENDIX C. Analyses of Variance (ANOVA)

Sulfate 1998	Sulfate 1990	
Sta665	Sta101	
11	21.6	
4.5	47.2	
39.9	48	
38.9	46.8	
55.7	45.4	
8.5	20.5	
49.6	22.3	
41.6	14	
43	13.3	
33.8	7.1	
42.3	4.4	
44.7	7.7	
4.5	4.4	min
55.7	48	max
34.5	24.9	avg
16.9	17.2	stdev
12	12	count

Anova: Single Factor (Sulfate)

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Sta665	12	413.5	34.45833333	285.657197
Sta101	12	298.3	24.85833333	295.8226515

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	552.96	1	552.96	1.901905978	0.181725494	4.300943601
Within Groups	6396.278333	22	290.7399242			
Total	6949.238333	23				

Cond 1998	Cond 1990	
Sta665	Sta101	
365	210	
410	104	
450	352	
448	357	
416	432	
299	137	
275	459	
208	404	
275	382	
196	361	
100	359	
64	375	
64	104	min
450	459	max
292.2	327.7	avg
131.3	114.0	stdev
12	12	count

Anova: Single Factor (Conductivity)

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Sta665	12	3506	292.1666667	17243.24242
Sta101	12	3932	327.6666667	12993.15152

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	7561.5	1	7561.5	0.500158849	0.486854846	4.300943601
Within Groups	332600.3333	22	15118.19697			
Total	340161.8333	23				